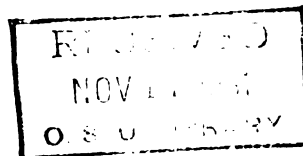


DEPARTMENT OF COMMERCE

UNITED STATES BUREAU OF MINES
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INFORMATION CIRCULAR

SAFETY IN THE IRON MINES OF THE MENOMINEE RANGE,
MICHIGAN



BY

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SAFETY IN THE IRON MINES
OF THE MENOMINEE RANGE - MICHIGAN¹

By F. S. Crawford²

After many years of safety activity in the United States in one form or another it becomes increasingly evident to those in contact with safety work that to achieve continuous good results in accident prevention there must be an aggressive organization behind the safety movement at each mine with fairly definite plan and policy. A study of the methods used by various companies and the results they have attained will be of value to the common cause of safety promotion.

A study has been made of the safety records of the Menominee iron range in the Lake Superior district, and of data from the county mine inspector's report. Several companies on this iron range that have attained a certain measure of success in their work of accident prevention have given data, and a summary of their safety methods is presented.

RECORD OF MENOMINEE RANGE

The Menominee iron range of Michigan lies in the southern portion of the upper peninsula of Michigan, bordering on Wisconsin. It consists of two main divisions--the West Menominee Range, situated in Iron County in the vicinity of Iron River and Crystal Falls, and the East Menominee range situated in Dickinson County in the neighborhood of Iron Mountain, Mich. The mines about Iron River and Crystal Falls are peculiarly subject to fires in a carbonaceous, sulphur-bearing black slate which appears in the footwall. This gives considerable trouble because fires in this material start from spontaneous heating. The methods of mining are top slicing and open stoping, working on benches along the sides of the stopes. The character of the ground varies from medium soft ore to relatively hard ore which permits open stoping. Approximately one-third of the operating mines are equipped with a fan for main mechanical ventilation. The remainder are ventilated by natural draft. The East Menominee range is the older, top slicing having been used there for a number of years, and the timber mats have been well developed. In common with all districts, some companies pay more attention to safety than others, although those which do not have the best records do pay some attention to safety.

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During the past three years the annual production per man employed has remained about constant, but in many mines a general decrease is shown in the accident record. The variation in the results attained can be ascribed mainly to the earnestness with which accident-prevention work is pursued, essentially regardless of the method of mining used. This is shown to be generally true, because the record indicates a steady decrease in one mine with an active safety department, while in adjoining mines with the same kind of ground and method of mining but where not such intensive attention has been paid to safety work, the accident record is high.

The county mine inspectors' reports for Dickinson and Iron County show the following injury record for the Menominee Range (Table 1):

Table 1.—Injury record for the Menominee range, 1924-30.

IRON COUNTY							
	1924	1925	1926	1927	1928	1929	1930
Total fatal and lost-time accidents per 100 men employed	16.5	16.5	15.6	14.0	8.9	6.5	4.5
Total minor accidents causing 1 to 10 days lost time per 100 men employed	6.3	6.8	6.0	4.4	3.1	3.3	2.4
Total fatal and serious accidents causing over 10 days lost time per 100 men employed	10.2	9.7	9.6	9.6	5.8	3.2	2.1
DICKINSON COUNTY							
Fatal and compensable ¹ accidents per 100 men employed	1.7	2.4	2.4	1.6	2.2	1.6	2.4

¹ Compensable accidents only are reported. This includes those causing more than 7 days lost time beyond the day of injury.

The two counties do not report their accidents in the same way, so it is impossible to make a summary for the Menominee range as a whole on a common basis. The Iron County report shows the lost-time accidents divided into those causing time lost of 1 to 10 days, 10 to 30 days, and 30 days or more. The 1 to 10 day classification includes all the noncompensable lost-time accidents and some compensable accidents which have gone beyond seven days. However, the foregoing record shows that Dickinson County has enjoyed a low injury record for the period from 1924 to 1930, with an average for the period of approximately two compensable or fatal accidents for each 100 men employed. We may consider a fatal injury as a serious injury which has resulted fatally; some serious injuries miss being fatal only by a very narrow margin. Two of every 100 men are seriously or fatally injured in the Dickinson County mines every year; this may be interpreted to mean that on the average a man may work in Dickinson County mines 50 years before he is seriously injured.

The record for Iron County does not start out well in 1924, but much progress has been made since that time; the accident rate has dropped steadily. Some companies which had been carrying on more or less safety work have attacked the problem with greater vigor and with some change of method in the last few years. The minor accidents causing time lost from 1 to 10 days have been steadily reduced from 6.3 per 100 men in 1924 to 2.4 in 1930. The number of those more seriously and fatally injured has also dropped steadily from 10.2 in 1924 to 2.1 in 1930. A continuation of the present rate will make the chances of avoiding injury in Iron County mines practically equal to those of Dickinson County. Thus, the average miner on the Menominee range, based on the record so far attained in both counties, may work 50 years before being seriously or fatally injured.

There are nine companies producing iron ore in Iron County and operating 24 mines. In Dickinson County, companies which also operate in Iron County operate six mines, producing practically all of the output. Tables 2 and 3 list the individual records of these companies.

Table 2.- Accident record of Menominee iron range in Iron County

Item	1924									Total
	Company									
	A	B	C	D	E	F	G	H	I	
Average men employed	795	776	305	140	203	222	67	70	86	2820
Fatal accidents	1	5	0	0	0	1	0	1	1	9
Lost-time and fatal accidents	70	147	65	20	19	30	6	22	12	446
Fatal accidents per 1,000 employed	1.3	6.5	0	0	0	4.5	0	1.4	1.2	3.2
Lost-time and fatal accidents per 100 employed	8.8	18.9	21.3	14.3	9.4	13.5	8.9	31.4	13.9	16.5
1925										
Average men employed	883	914	293	130	190	273	78	65	34	2695
Fatal accidents	1	2	1	0	1	3	0	0	0	8
Lost-time and fatal accidents	140	152	61	18	16	49	13	15	2	444
Fatal accidents per 1,000 employed	1.1	2.2	3.4	0	5.3	11.0	0	0	0	3.0
Lost-time and fatal accidents per 100 employed	15.8	16.6	20.8	13.8	8.4	18.0	16.7	23.0	5.9	16.5
1926										
Average men employed	745	806	333	100	175	267	105	71	49	2655
Fatal accidents	0	1	0	0	0	0	0	1	0	2
Lost-time and fatal accidents	108	138	53	17	6	45	16	16	5	415
Fatal accidents per 1,000 employed	0	1.2	0	0	0	0	0	1.4	0	2.6
Lost-time and fatal accidents per 100 employed	14.5	17.1	15.9	17.0	3.4	16.9	15.2	22.6	10.2	15.6
1927										
Average men employed	735	757	356	110	175	175	124	67	55	2611
Fatal accidents	2	2	0	0	0	1	1	1	0	7
Lost-time and fatal accidents	138	123	5	27	3	29	13	18	9	366
Fatal accidents per 1,000 employed	2.7	2.6	0	0	0	5.7	8.1	1.5	0	2.8
Lost-time and fatal accidents per 100 employed	18.7	16.2	1.4	24.6	1.7	16.6	10.5	26.8	16.4	14.0

**Table 2.- Accident record of Menominee iron range
in Iron County - Continued**

1928										
Item	Company									Total
	A	B	C	D	E	F	G	H	I	
Average men employed	700	647	380	113	187	159	100	63	57	2452
Fatal accidents	2	2	0	1	0	0	0	1	0	6
Lost-time and fatal accidents	114	36	3	20	5	18	3	11	5	219
Fatal accidents per 1,000 employed	2.9	3.1	0	8.9	0	0	0	15.9	0	2.5
Lost-time and fatal accidents per 100 employed	16.3	5.6	0.8	17.7	2.7	11.3	3.0	17.4	8.8	8.9
1929										
Average men employed	618	516	407	147	182	108	88	58	61	2287
Fatal accidents	3	3	2	0	0	1	0	2	0	11
Lost-time and fatal accidents	58	14	7	33	7	12	4	9	4	148
Fatal accidents per 1,000 employed	4.9	5.8	4.8	0	0	9.3	0	34.5	0	4.8
Lost-time and fatal accidents per 100 employed	9.4	2.7	1.7	22.4	3.8	11.1	4.5	15.5	6.6	6.5
1930										
Average men employed	613	521	405	164	146	237	84	60	39	2265
Fatal accidents	2	5	0	0	0	1	0	0	0	8
Lost-time and fatal accidents	17	12	5	25	9	22	3	4	4	101
Fatal accidents per 1,000 employed	3.3	9.6	0	0	0	4.2	0	0	0	3.5
Lost-time and fatal accidents per 100 employed	2.8	2.3	1.2	15.3	6.2	9.3	3.6	6.7	10.0	4.5

Table 3.- Accident record of Menominee iron range in Dickinson County

1924				
Item	Company			Total
	A	B	E	
Average men employed	347	80	944	1371
Fatal accidents	0	0	0	0
Lost-time and fatal accidents	12	2	8	22
Fatal accidents per 1000 employed	0	0	0	0
Lost-time and fatal accidents per 100 employed	3.5	2.5	0.8	1.7
1925				
Average men employed	377	76	805	1258
Fatal accidents	1	0	5	6
Lost-time and fatal accidents	6	10	14	30
Fatal accidents per 1,000 employed	2.7	0	6.2	4.8
Lost-time and fatal accidents per 100 employed	1.6	13.2	1.7	2.4
1926				
Average men employed	391	73	777	1241
Fatal accidents	1	0	2	3
Lost-time and fatal accidents	9	8	13	30
Fatal accidents per 1,000 employed	2.6	0	2.6	2.4
Lost-time and fatal accidents per 100 employed	2.3	11.0	1.7	2.4
1927				
Average men employed	331	103	803	1287
Fatal accidents	0	0	2	2
Lost-time and fatal accidents	2	3	15	20
Fatal accidents per 1,000 employed	0	0	2.5	1.6
Lost-time and fatal accidents per 100 employed	0.5	2.9	1.9	1.6
1928				
Average men employed	355	137	764	1256
Fatal accidents	0	0	1	1
Lost-time and fatal accidents	1	8	19	28
Fatal accidents per 1000 employed	0	0	1.3	0.8
Lost-time and fatal accidents per 100 employed	0.3	5.8	2.5	2.2
1929				
Average men employed	340	141	732	1213
Fatal accidents	1	0	3	4
Lost-time and fatal accidents	8	2	9	19
Fatal accidents per 1,000 employed	2.9	0	4.1	3.3
Lost-time and fatal accidents per 100 employed	2.4	1.4	1.2	1.6
1930				
Average men employed	332	145	697	1174
Fatal accidents	1	0	2	3
Lost-time and fatal accidents	5	5	18	28
Fatal accidents per 1,000 employed	3.0	0	2.9	2.6
Lost-time and fatal accidents per 100 employed	1.5	3.5	2.6	2.4

Three companies employing 1,539 of the total of 2,265 men in Iron County mines had only 34 of the total of 101 time-lost and fatal injuries of all descriptions. The other companies, employing the remaining 726 men, had 67 accidental injuries. The rate for the first group was 2.2 per 100, whereas the rate for the second group was 9.2 per 100. The high accident rates are found in the mines of small companies which, however earnest is their desire to prevent accidents from either a humanitarian or an economic consideration, have not yet succeeded in using the proper means to accomplish this purpose. It is apparently more difficult to organize safety activities at the single small operation than at the single large mine or group of mines, large or small, of the large company (this is so in other industries); much of this difficulty is probably due to the fact that the small operator feels that he can not afford the services of a safety engineer and rarely has anything like an effective safety organization or working plan.

There is now no reason why a fairly large company, with several mines, should continue to have a bad safety record; this also means that the smaller companies should be able to secure similar results by combining their efforts, at least in the forwarding of safety work.

By organization of safety committees to inquire into the causes of accidents, engaging in educational work among the men, and using some measure of discipline to back up the safety rules, the men can be brought to be more and more safety conscious and thus avoid accidents and resultant personal injuries. The employment of a safety inspector, engineer, or director is generally necessary to see that the work is carried on steadily. The small company usually feels that it can not afford the added expense of the safety engineer; in many cases the question might well be asked, Can the operation afford not to have a safety engineer, and can it afford not to carry on accident-prevention work? Numerous articles have appeared recently in the technical press and in the proceedings of various engineering and safety organizations showing the direct and indirect causes of accidents. Some small mines may operate well without a safety engineer, but someone should be responsible for carrying on a ceaseless safety program, in more or less detail. In a small operation this may be made part of the duties of the mining engineer or assistant superintendent, but the higher up among the official personnel is the position of the man in charge of safety work, in general, the better will the work succeed. The small operator might well look upon the safety man as primarily the safety director, who would also be assistant to the superintendent or assistant superintendent as well, and employ his time with efficiency and operating problems when not engaged in safety activities.

The fundamental requirement for the success of accident-prevention work at any operation is that the management should be heart and soul and aggressively behind the safety work; following this, the men should be made to realize this attitude of the management. Besides continual emphasis on wise safety regulations, all rules should be backed up by discipline.

Of the nine companies operating 30 mines on the Menominee range, all but two small companies have a safety engineer. One of the small companies recently established a safety organization in charge of a safety engineer, and this action is showing good results, as far as may be judged by the record of one year; the injury record for 1930 is less than half that of 1929. The two companies which do not have a safety engineer are not showing consistent results in preventing accidents, although their foremen and superintendents are quite earnest in their desire to do so. The injury rate is low one year and high the next, and in general is considerably higher than at the other mines which have active safety organizations. The safety practices of three operators will now be described:

Oglebay-Norton & Co.

Oglebay-Norton & Co. operates three underground iron mines on the Menominee range. One of these mines was closed in the fall of 1930, but all three were in operation during 1929. These mines are the Berkshire and the Brule mines of the Brule Mining Co., and the Bristol mine of the Bristol Mining Co. Each of the subsidiary companies has a safety engineer. As methods are similar at each mine, description of the safety organization will be confined to that of the Brule Mining Co.

Berkshire Mine

The Berkshire mine produced 224,686 tons of medium hard hematite in 1929 and employed an average of 141 men - 94 underground and 47 on surface, in shops and office. Mining is by the top-slicing and caving systems, which are in general use on the Menominee range wherever the ore is too soft to mine by open stopes. A main ventilating fan is installed on the surface; part of the mine is ventilated by natural draft. Considerable trouble is experienced with black-slate fires; as soon as the black slate of the footwall is crushed and exposed to air and moisture it catches fire by spontaneous heating.

Labor turnover is at the rate of six men per month.

Labor Conditions

A mixture of all European races is employed in the following percentages:

<u>Nationality</u>	<u>Per cent</u>	<u>Nationality</u>	<u>Per cent</u>
Swedish	23.6	German-Polish	1.4
Italian	14.3	Hollander	1.4
Finnish	13.6	Tryolian	1.4
Polish	11.4	Armenian	0.7
French	5.0	Austrian-Croatian	.7
Croatian	3.6	Belgian	.7
British	3.6	Bulgarian	.7
Swede-Norwegian	2.9	Finn-Italian	.7
Austrian	2.9	German	.7
Irish	2.2	Norwegian	.7
Canadian-French	2.2	Scotch-British	.7
British-American	1.4	Swede-Irish	.7
British-German	1.4		
German-Italian	1.4		

Safety Organization

General Safety Committee.— The general safety committee convenes monthly at different properties operated by the company in Michigan, Wisconsin, and Minnesota. It is composed of the district manager, the general superintendents, superintendents, and safety engineers of all Oglebay-Norton & Co. properties in the Lake Superior district. The meeting is attended by foremen of the mine at which the meeting is held. A record is made of the proceedings, and copies are sent to all subsidiary companies affiliated with Oglebay-Norton & Co.

Central Safety Committee.— The central safety committee is the local mine safety committee. It is composed of the general superintendent, superintendent, safety engineer, the heads of all surface operating departments, and the underground foremen. The safety engineer presides at these meetings. Records of the proceedings are forwarded to all company properties.

Daily Safety Committee Meeting.— The daily safety committee meeting plays an important part in the safety organization. It is made up of the same members as the central safety committee and convenes at 7:30 a.m. daily. No permanent records are kept of the proceedings, the object being to outline each day's work so that all operations will function most efficiently and safely.

The safety engineer is regarded as the key man in bringing about cooperation between departments, and in organizing ways and means for a careful study of all conditions which might cause accidents. He has direct charge of the safety movement and works with the central safety committee and the superintendent toward the betterment of general safety conditions.

Safety Inspection

There are four separate forms of safety inspections, two of which are primarily for the purpose of building up safety consciousness among the employees, and as such are effective.

The foreman at the end of each shift makes out a safety and cleanliness report on every working place under his jurisdiction. The contents of this report are observed by the foreman on the opposite shift when he reports for duty, and the report is countersigned by him.

The safety engineer submits to the central safety committee a monthly inspection report covering every working place on the property, both surface and underground.

New underground employees are assigned to the duties of underground safety inspectors for the first day of their employment. They make a trip through the mine with either the section foreman or the mining captain, and are required to make a written report of their findings.

Men are selected periodically, and at random, from the underground forces to act as safety inspectors. They are required to make written reports. The result is that the men have been kept alert to dangers, and each man has learned to think about the hazards in his own job. It has gradually instilled the safety idea into the entire force.

Surface inspections as to cleanliness are made by the safety engineer every three months. Surface openings, such as test pits and shafts are inspected once every month. All surface openings are covered where possible and fenced off. All fences and warning signs are inspected regularly every month and a report is forwarded to all other Oglebay-Norton & Co. properties.

No regular form is used for inspections. The inspectors' reports are discussed at the central safety committee meetings, and the shift bosses' daily safety and cleanliness reports are discussed at the daily safety committee meeting every morning.

Safety Education

Bulletin Boards.— The company subscribes to a commercial bulletin board service and to the National Safety Council. The board is made up of three panels. The center one is used for pictures of current events and world news. The side panels are used for safety posters and pictures.

Foremanship Education.— No night classes have been established, but the company carries on foremanship training through the pamphlets on this subject issued twice monthly by the commercial bulletin service to which they subscribe.

Safety Education in Public Schools.— The local schools and civic organizations also carry on safety activities.

First-Aid and Mine Rescue Training.— The Berkshire mine received a 100 per cent training certificate in 1930 after all the men had been given first-aid training by the United States Bureau of Mines. When enough new men have accumulated to make a class, they are trained by the company instructor and the mine thus kept up to 100 per cent. The new men are examined for certificates by bureau instructors. The old men are also retrained at intervals of one year.

Twenty-four men have been trained in the use of mine rescue oxygen breathing apparatus. Five sets of McCaa 2-hour apparatus and two All-Service gas masks are kept on hand, also four canisters, two stretchers, four blankets, and a complete assortment of splints. The men are re-trained at intervals of several months and new men are trained from time to time.

Safety Standards

Drifting.-- Timber is used in all drifting and crosscutting in the iron formation or in iron ore where the opening is larger than 4 feet wide and 7 feet high. No timber is used where the ground is hard enough to stand without support. In all doubtful ground, timber is used. The back, sides, and breast are required to be trimmed as soon as miners go back after a blast. Where timber is used, the back is required to be blocked at once, using four or more pieces of lagging, 8 feet long, to block ahead.

Raising.-- All raises in ore or in iron formation are cribbed except in open stopes. Raises in black slate or gray slate are not cribbed if the slates are hard and of a suitable nature. Single cribbed raises are 4 by 3 feet, while double-cribbed raises are 3 by 9 feet. A safety chain is stretched across all raises while they are being driven. This device is a chain net formed of heavy chains of mesh large enough to allow the dirt to go through, but small enough to catch a man if he falls. After the blast, compressed air is blown for a reasonable length of time, then the miner climbs up and fastens the chain across the opening 15 to 20 feet from the back before he trims it down. Eight-foot ladders are used. This length allows the men to carry the ladders close enough to the back so that he does not have to climb on the cribbing to get up close enough to the back to trim it. The ladders are set off to one side and raised 4 inches from the cribbing to allow foothold. Ladders are spliced together by laying a 2-inch board 2 feet long under the ladder and parallel with it. This allows the dirt to go through the splice under the ladder rungs and does not interfere with the footing when climbing. The other side of the ladder is nailed to the side cribbing. All raises are covered, both the mill and the ladder road. All manway raises have doors over the top and gates at the bottom, opening inward. The door over the timber slide in the manway raise is made of metal strips spaced about 1 inch apart to allow for ventilation. A solid door is used over the ladderway.

Blasting.-- When blasting in drifts there are always two men to light the fuse. An extra carbide lamp is furnished every gang (a gang consists of two men) of miners for use when lighting fuses. In sub-drifts, one man lights while the other is present. In raises, one man lights while his partner waits for him at the bottom of the raise. All blasting is done at noon or when the miners go off shift. This is done so that the face may be cleared of gases in time to resume work, and to avoid danger due to delayed blast.

Fire Protection.-- The air lines are connected to the water lines so that water can be turned into them in case of fire in a place not provided with a water line. Fire doors are placed on each level in each drift. Fire extinguishers are in readiness in the powder house, pump house, and at the stations in each level. The men are instructed as to what to do in case of fire. Maps are placed in the dry house, shop buildings, and engine house to show the position of hydrants and to give instructions in case of fire.

Safety Rules.—The safety rules of the company are being compiled and will be put in book form. All men underground and on the surface are already acquainted with the rules, and all new rules are explained to the men by the bosses.

Supervision.— The mine has a mining captain, two shift bosses, and one trammer boss, each man looking after about 35 men. One shift boss looks after the sixth level and the other the seventh. All places are visited twice a day or oftener, at least once in the morning and once in the afternoon.

Discipline.— Safety rules are enforced by reprimand and other forms of discipline. If a man violates a rule he is given a lecture the first time, if it is a minor offense. He may be given a day or more lay-off, or discharged, depending upon the nature of the violation. The man who continues to be careless in his habits is discharged.

Rewards.— If the mine has worked one month without a lost-time accident, tobacco, candy, or other similar reward is given to each man on the first of the month. When the mine has gone one year without a lost-time accident every employee is given a pocket knife with his name on it. The company has a safety trophy which is awarded to the mine that works three months without a lost-time accident. This trophy was in the possession of the Berkshire mine for the fall of 1930. If two mines have gone three months without a lost-time accident the trophy is awarded to the mine having the most man-hours. The Berkshire mine now has the "Sentinels of Safety" trophy of the national safety competition for the second consecutive year, as it was won by them in 1928 and 1929. It is worthy of note that this trophy was also won in 1927 by the Bristol mine operated by Oglebay-Norton & Co. under the same general superintendent, F. J. Smith.

Protection

Protective Clothing and Wearing Equipment.— At present all men underground at the Berkshire mine are equipped with hard hats, gloves, and goggles which are worn around the neck when not in use. All men wear hard-toed boots.

Safety belts are always worn when landing timber and other material from the raises. They are also worn wherever a man is working over an opening, or whenever it is considered necessary. These belts are tested every six months by a drop of 6 feet with a weight of 250 pounds. New ropes are put on the belts while they are being tested and again every three months. These belts are made of two thicknesses of heavy harness leather with a D-ring. A $\frac{3}{4}$ -inch hemp rope is braided into a snap. The snaps and the new ropes are tested with the belts.

Mechanical Guarding.- Gates are placed at the bottom of every manway raise, also at the top of every manway raise, in cases where no doors are used. A heavy iron gate is used on the surface shaft landing and at each underground shaft landing. Forepoling is required whenever timber must be used underground in advancing openings. All slushers are guarded by $\frac{1}{4}$ by 1 inch iron frame with vertical and horizontal rollers. Hinged covers fit over the drums.

Fire Protection

Fire extinguishers are available at the following places: two at the seventh-level powder house, one each at the fifth and sixth level pump houses, and one at the fifth and sixth level shaft stations.

Many fire extinguishers are placed both underground and on the surface. The kinds and locations of these fire extinguishers are as follows:

Distribution of fire extinguishers

Number	Capacity	Extinguisher type	Place
1	1 Qt.	Pyrene	Seventh level powder house.
1	2½ Gal.	Soda acid	Seventh level powder house.
1	1 Qt.	Pyrene	Fifth level pump house.
1	2½ Gal.	Soda acid	Fifth level station house.
1	1 Qt.	Pyrene	Sixth level pump house.
1	2½ Gal.	Soda acid	Sixth level station house.
1	2½ Gal.	Soda acid	Lander's shanty.
1	1 Qt.	Pyrene	Do.
1	2½ Gal.	Nonfreeze	Saw mill.
1	1 Qt.	Pyrene	Sawmill motor room.
2	1 Qt.	Pyrene	Boiler room.
2	2½ Gal.	Soda acid	Dry.
1	1½ Qt.	Pyrene	Dry.
1	1 Qt.	Pyrene	Blacksmith shop.
1	1½ Qt.	Pyrene	Machine shop.
1	1½ Gal.	Soda acid	Do.
1	1 Qt.	Pyrene	Carpenter shop.
1	1 Qt.	Pyrene	Electric shop.
2	1½ Qt.	Pyrene	Engine house.
1	1 Qt.	Pyrene	Oil house.
2	1 Qt.	Pyrene	Engine house basement.
1	1 Qt.	Pyrene	Warehouse office area.
2	2½ Gal.	Nonfreeze	Do.
1	1 Qt.	Pyrene	Sample room.
1	1 Qt.	Pyrene	Laboratory.
1	2½ Gal.	Soda acid	Do.
1	1 Qt.	Pyrene	Office basement.
3	2½ Gal.	Soda acid.	Office main floor and upstairs.
2	1 Qt.	Pyrene	Garage.
1	1 Qt.	Pyrene	Transformer house.
1	1½ Qt.	Pyrene	Mounted on welding machine.
1	1 Qt.	Pyrene	Ford sedan.
1	1 Qt.	Pyrene	Chevrolet truck No. 1.
1	1 Qt.	Pyrene	Chevrolet truck No. 2.

Eight houses on the mining company location have fire extinguishers. These are both pyrene and soda acid. The superintendent's, engineer's, and cashier's residences have large fire extinguishers. Three sets of fire ladders are maintained by the company at one location and two at another. These are inspected regularly. There are four fire hydrants, one at the Berkshire location and three at the Lennox location. Five hundred feet of 2½-inch fire hose and two nozzles are kept on a cart at the mine.

Medical Service

All new employees are given a physical examination before they are hired, and all old employees are given an examination by the mine doctor once a year. Any man who quits his job, or is discharged, or any man who takes leave of absence for over 30 days must be reexamined as a new employee. This does not apply to men who are laid off due to a temporary shutdown.

A new 32-bed hospital was built by the mining companies in the district in 1930 in the city of Stambaugh, Mich.

All cuts, scratches, bruises, and small injuries are treated by first-aid men or by the safety engineer in the dry house. If the injury is of such a nature that it requires the doctor's attention, the patient is sent at once to his office for treatment. It is left to the doctor to decide when a man shall return to work after an injury. An accident check-up system has been perfected whereby it is known at the end of each shift whether an accident of any kind has occurred. This system originated as a result of serious infections developing from small cuts and bruises of which the foreman had no knowledge. With this system in force, no injured employee can leave the property without first receiving medical treatment. A slip is put up in the "dry" each day with each employee's check number printed upon it. If a man receives a cut, bruise, or any small injury, he puts O after his number as he leaves at night; if he received no injuries whatsoever, he places X after his number. Whether he is injured or not he must mark the card.

Accident Reports

The doctor makes a report of the injury as to the nature and the cause. The safety department gets a report of the injury from the underground foreman, and the foreman's report is also sent to the office.

In classifying accidents, the man is paid full time for the day injured so that the day of injury is not counted as lost time.

In returning a man to work, he is often given an easy job until he is able to take over his regular task; as long as he is actually employed by the company, whether at the same job, at which he was injured or at some other job, it is not classified as lost time. The severity of the accident is determined by the doctor and it devolves upon him to determine whether the man is fit for shop work, underground work, or whether he is able to go back to work at all for some time. The injured man must present a clearance from the doctor giving him permission to return before he is allowed to work by the foreman. Severity and frequency charts are made up each month.

Hiring New Men

A new employee is given a safety talk by the safety engineer before he goes to work, and the first day the new man acts as a safety inspector, as mentioned above. While he goes through the mine with the foreman, he is given instruction on safety methods, safety rules, and other work. The new man then makes out a report on the condition of the mine, relative to safety and cleanliness, as well as making any suggestions or advancing any ideas which he may have along these lines.

Checking up Mental and Physical Fitness for Job

No new men, or men not known well enough by the foreman, are given hazardous jobs. Where a job is extra hazardous, a boss is always present until the job is completed.

The boss checks up on a man's mental and physical fitness for extra hazardous jobs by his personal observation of him, through contact with him day after day, and by his habits, especially as to whether he is careful or careless. He also judges by the condition of his working place, by his actions, thoughts, and ideas, and by his experience in the line of work for which he is being considered.

Compensation and Welfare

Compensation is covered by the provisions of the State Compensation Law of Michigan, which allows compensation after absence of seven days due to injury, the amount varying with the nature of the injury. The company has no special pension fund or death fund. It is self-insuring under the compensation law and sets up a reserve to compensate for accidents by charging itself a certain per cent of the payroll each month.

Inasmuch as the company is self-insuring, any reduction in the accident rate has a direct effect upon the insurance rate. If the percentage of the total payroll is not large enough to set up a reserve, it is increased.

Table 4 following is the safety record of the Berkshire mine during the last 11 years.

Table 4.- Safety record of the Berkshire mine, 1920-1930

Year	Average men	Total hours worked	Total shifts worked	Fatal accidents	Nonfatal lost-time accidents		Slight injuries no lost time		Days lost in nonfatal accidents		Total lost-time accidents and fatal accidents per 100 men employed	Frequency rate, lost-time and fatal accidents per million man-hours
					Com-pen-sable	Non-com-pen-sable			Com-pen-sable	Non-com-pen-sable		
1920	185	475,336	57,228	0	18	30	31		1827	88	26.0	101
1921	107	190,631	22,951	0	11	10	4		152	32	19.6	110
1922	124	312,937	37,676	0	18	17	14		340	47	28.2	112
1923	166	427,527	51,472	0	17	20	23		682	51	22.3	86.5
1924	163	415,051	49,970	0	16	22	19		453	69	23.3	91.5
1925	180	458,275	55,174	1	17	22	36		723	60	22.2	87.3
1926	184	467,974	56,259	0	8	13	67		362	27	11.4	45.0
1927	186	471,916	56,897	0	3	0	55		113	0	1.6	6.4
1928	177	403,487	48,632	0	0	0	40		0	0	0.0	0.0
1929	141	345,695	41,612	0	0	0	44		0	0	0.0	0.0
1930	132	283,807	34,110	0	0	0	32		0	0	0.0	0.0

Table 5 lists minor no-lost-time accidents due to various causes during the years 1928, 1929, and 1930:

Table 5.- Minor no-lost-time accidents in the Berkshire mine during a three-year period

	1928	1929	1930
Fall of rock or ore	8	5	7
Rock or ore at working place or chute	7	5	3
Timber or hand tools	7	11	10
Haulage	3	-	-
Machinery	2	2	-
Overcome by gas	1	-	-
Nails and splinters	2	2	2
Electricity	1	-	-
Other causes	2	5	6
Fall of person	4	5	1
Dirt in eye	3	9	3

M. A. Hanna Co.

The M. A. Hanna Co. operated six underground mines on the Menominee range in 1929 and 1930 and produced a large part of the total output of iron ore for the range. Three of the Menominee range mines produce hard ore; the others produce soft ore. In the whole Lake Superior district this company operated 16 mines in 1929, eight being underground and eight open pit. An average of 720 men were employed in the open pits and 821 in the underground mines. Two of the underground mines are equipped with fans for main mechanical ventilation; the other six depend upon natural draft.

Labor Conditions

Of a total of 1,541 men required for the 16 mines, it was necessary to hire 148 new men per month, an average of nine at each mine. When the seasonal nature of open-pit work is considered, this is a comparatively low labor turnover.

The nationalities employed by this company in the Lake Superior district were as follows:

<u>Nationality</u>	<u>Per cent</u>	<u>Nationality</u>	<u>Per cent</u>
Finnish	18.1	French	3.5
Italian	13.7	Norwegian	3.1
Swedish	13.6	Irish	2.1
Austrian	11.0	Serbian	2.1
Polish	8.5	Scotch	1.0
British	5.9	Belgian	0.9
Croatian	4.7	Bulgarian	0.9
German	4.0	Greek	0.6
Slovanian	3.9	Miscellaneous	2.4

Of these various nationalities, 45 per cent are American born.

Safety Organization

The plan of the safety organization is not elaborate. A full-time safety engineer is employed whose duties are to make safety inspections, conduct safety meetings, and train mine rescue crews. This plan has been in effect for 15 years.

Safety Committees and Safety Meetings.- There are no standing safety committees. However, a general meeting of the superintendents, mining captains, shift bosses, mechanics, electricians, and other foremen is held at the Michigan and Minnesota district offices once a month. A meeting of all employees is also held once a month at each of the various properties.

The lost-time accidents are read and discussed at these meetings. In addition, there is a discussion of accidents which have not involved lost time, discussion of safety rules, safety suggestions, safety clothing, unsafe practices, accidents at mines of other companies, new safety kinks and devices. Outside speakers are also brought in to talk before these meetings, and salesmen from the various safety equipment companies are invited to display and talk about their goods. There have been talks by oxyacetylene welding experts and moving picture displays of safety and other educational files. Safety suggestions are requested from those attending both the general meetings and the workmen's meetings. Various safety committees make their report at the general workmen's meetings.

The number of safety meetings of employees held during 1929 at the various mines as follows:

<u>Mine</u>	<u>Meetings</u>	<u>Mine</u>	<u>Meetings</u>
Homer	12	Mesabi Chief	4
Harold	11	Susquehanna	4
Zimmerman	11	La Rue	2
Rogers	10	Richmond	1
Wabigon	9	South Uno	1
Hiawatha	7	Maroco	1
Loretto	7	Florence	0
Bates	5	Total	85

Safety Education

Bulletin Boards.- The bulletin boards of the Elliott Service are used at all properties. In addition to the Elliott Service there are also displayed National Safety Council bulletins, local posters, honor rolls, announcements, and newspaper clippings of accidents at other companies' mines. When a man breaks his goggles with the saving of his eyes the goggles are displayed as an inducement to all men to wear their goggles.

Mine Rescue Training.— The company has eight McCaa apparatus and six All-Service gas masks available for use in case of mine fires. Forty men have been trained in the use of mine rescue breathing apparatus at the five properties in the Iron River district of Michigan, or eight men at each property. These men are re-trained every three months by the company safety engineer.

Community Meetings.— Some safety education is done in the public schools through the cooperation of the company. Other educational methods are the community safety meetings. A safety talk is given at these meetings which is followed by safety movies and other educational films and a two-reel comedy. As a rule a 5-piece orchestra is furnished to give music, and after the meeting there is dancing and a lunch. Twenty community meetings were held in 1929 at the various properties as follows:

<u>Mine</u>	<u>Meetings</u>	<u>Attendance</u>
Mesabi Chief	4	1250
Harold	3	850
La Rue	2	500
Loretto	2	400
Richmond	2	400
Rogers, Hiawatha, and Bates	1	400
Wabigon	2	375
Zimmerman	2	300
Wakefield	1	175
Susquehanna	1	175
Total	20	4825

Safety Inspection

The safety engineer inspects all properties regularly and continuously. Inspection is made of the surface and underground, during which particular attention to the condition of guards for machinery, loose material, safe and unsafe practices, observance of safety regulations by the men, the regular inspection of the hoisting cable, the monthly testing of safety catches on the cages, inspections for fire hazards, and to seeing that second exits are in good condition and that necessary precautions are taken to protect the workmen.

A safety committee of workmen inspects each property each month, making a report at the general safety meeting. No special report forms are used. A weekly report is sent to the general manager, assistant general manager, general superintendent, claims manager, and Cleveland office of the company.

Safety Standards for Operation and Safety Suggestions

As a result of safety meetings, a number of safety suggestions have been made and collected by the company. The safety engineer does not collect the minutes of all safety meetings or the reports of all mine safety committees,

but even with incomplete records he has a total of 677 recommendations made by employees at the various properties. ~~These~~ serves to show the importance of having mine safety committees and holding regular monthly safety meetings of all employees. These safety suggestions are under the following classifications:

- Safety suggestions.
- Suggestions for sinking safely.
- Suggestions for drifting safely.
- Safety suggestions for miner in driving raises.
- Safety suggestions for tramming.
- Safety suggestions for stope mining.
- Accident prevention in slices.
- Safety suggestions for men working around shovels.

Safety Rules

The safety regulations of the company have been issued in three sections. The first is for the surface - mechanical and electrical; the second for underground mining; and the third for open-pit mining. These books are given to the workmen when they are employed.

Supervision

The average number of men assigned to a shift boss is 34, a number small enough to allow him to visit each man at least two times per shift.

Rewards

Besides the community safety rallies, followed by the lunch, there are occasional safety dinners ~~tr~~ given for the foremen. Occasional prizes are given, such as pocket knives, turkeys, and match holders.

Protection

Hard hats are required at all underground properties. This rule is even extended to visitors, none of them being allowed to go below the collar of the shaft without wearing a hard hat. Goggles are furnished to all men who need them. Hard-toed boots are not required, quite likely due to the difficulty of getting men fitted to the hard-toed boots which have been available. However, the men are encouraged to wear them.

Miners on the benches along the sides of open stopes are required to wear a safety belt and rope at all times. All openings are protected by gates. The gates at the shaft are 6 feet high at all levels. Temporary forepoling is employed in driving drifts. Slushers or scraper hoists are completely guarded both from flying particles from the rope and from getting a hand caught between the rope and the rod. Both pyrene and soda-acid fire extinguishers are used.

Medical Service

A system of physical examinations for both new and old employees has been established by the company. Hospital and dispensary service is available to the men. For slight injuries, first aid is given at the mine, and if the injury is considered severe enough the man is then sent to the doctor.

Accident Reports

The first report of an accident is made by the foreman. The doctor also makes a report of the injury when the man reports to him for treatment. The men are paid full time for the day on which they are injured, so the day of injury is not classed as lost time. If a man fails to return to work the day after the accident it must be classed as a lost-time injury.

Hiring New Men

When a man is hired he is given his first safety instruction by the foreman who hires him. The foreman explains the company's safety policy and cautions him. He is then given a rule book and told to comply with all safety rules.

Compensation and Welfare

The company is self-insuring. In addition to the compensation which the law requires, all employees carry group insurance through the mining company, the minimum being \$1000, which is paid in full at death.

Pickands, Mather & Co.

Pickands, Mather & Co. produces iron ore at eight underground mines on the Menominee range of Michigan. During 1929, six of these mines were operated with a total production of 1,381,531 tons and an average of 980 employees. Three mines operated during 1929 have a main mechanical ventilation system, while the other three are ventilated by natural draft.

Labor Conditions

The percentage of nationalities employed is as follows:

<u>Nationality</u>	<u>Per cent</u>	<u>Nationality</u>	<u>Per cent</u>
American	37	German	1
Italian	16	Croatian	1
Finnish	12	Bulgarian	.7
Polish	9	Belgian	.5
British	5	Lithuanian	.5
Austrian	5	Dutch	.3
Swedish	4	Manx	.3
Canadian	2	Russian	.3

The labor turnover was at the rate of 2 per cent per month, or 20 new men were hired monthly.

Safety Organization

The general safety organization of Pickands, Mather & Co. is directed from the Cleveland office by M. D. McIntyre and Charles F. Haselton. The former, the head of the safety department at Cleveland, divides his time between safety work and handling safety insurance of all kinds. There is a range safety inspector for each of the three Lake Superior districts comprising the Minnesota ranges, with headquarters at Hibbing, the Gogebic and Marquette ranges, with headquarters at Ironwood, Mich., and the Menominee range, with headquarters at Caspian, Mich. On all ranges there are district safety inspectors working under the range safety inspectors.

Safety Committees and Safety Meetings.— Safety meetings are held quarterly. At these quarterly meetings all foremen, shift bosses, mining captains, mining engineers, superintendents, and general superintendents are present. The meeting is presided over by the range safety inspector. Accident records and statistics showing the causes of accidents, compensation costs, disability records, and the accidents themselves are discussed. Sometimes a group dinner is served at these meetings. At other times a smoker is held. Workmen's meetings have been held in the past, but they have been discontinued in recent years.

Safety Education

Bulletin boards are placed in various plants and are posted with daily bulletins. In addition to these bulletins there are also homemade bulletins on safety, sports, monthly accidents, reports, and other topics.

First-aid classes are held once a month at each mine.

Mine rescue training is given to about 40 men once a month. Twenty-five sets of apparatus are available.

Foremanship classes are held once a month.

The company cooperates with the schools in their safety educational work by furnishing safety bulletins.

Inspection

Safety inspections are made by the range safety inspector, the underground safety inspector, mining captains at each mine, the superintendents, assistant general superintendent, the general superintendent, and every official. These inspections are made every day. A report form is used for the hoist inspection and the monthly summary of safety inspections.

A recommendation slip is made out for each item to be corrected, following each inspection. These slips go to the responsible foreman and to the superintendent and are closely followed up. They are numbered consecutively and are carried as "uncompleted" until the condition is actually corrected.

Rules

Safety rules are furnished in the form of a book of rules for the foremen. There were formerly safety rules for workmen, but these have been discontinued. The company does not require any examinations on safety rules.

Discipline

Safety standards are enforced by a warning for the first offense, a lay-off for the second offense, and if there is a third infraction of the rules, the offender is dismissed.

Rewards

Competition for an annual prize is held within six groups of mines operated by this company in the Lake Superior district. Each employee of the winning mine in each group receives a prize. Any mine with a no lost-time record for the year is considered as tied for first place and is awarded the prizes. On the Menominee range there are two competitive groups, and in 1930 the Caspian mine and the West Vulcan mine were the winners. The Gogebic-Marquette district has three groups and Minnesota has two.

In addition to the yearly competitions, individual awards are made for monthly no disability records at each mine. These awards are based upon a cumulative credit system. When a mine goes through a month without disability, each employee receives a cash credit of 10 cents. If this is followed by a second month of no disability, 20 cents more is credited to each man. In the underground operations, for the third and each subsequent consecutive no-disability month 30 cents is credited. In the Minnesota open-pit operations, due to the better accident experience, the rate remains at 20 cents for the second and subsequent consecutive months.

These sums accumulate to each man's credit as long as there are no-disability months. The total credits at the end of the month are as follows:

Credits for no-disability months

Months	Underground	Minnesota open pits
1	\$0.10	.10
2	.30	.30
3	.60	.50
4	.90	.70
5	1.20	.90
6	1.50	1.10
7	1.80	1.30
8	2.10	1.50
9	2.40	1.70
10	2.70	1.90
11	3.00	2.10
12	3.30	2.20

When a lost-time accident occurs, a prize for the no-disability period is decided upon and each employee in the mine receives his award. After this the accumulation of credits starts again.

The prizes are based upon the amount of credits accumulated and are given in the form of merchandise of various kinds, such as blankets, pocket knives, wool socks, fishing tackle, and other useful things. Inasmuch as the company can purchase wholesale and gives the men the benefit of the wholesale price, the amount of the credit represents more in actual goods than the money would in the man's pocket if he were to purchase his own prize at retail cost.

Protection

Wearing Apparel.- Hard hats, hard-toed boots, goggles, and gloves are worn.

This company has so many cases on record in which hard hats saved head injuries on the Menominee range that it would make a long list. The safety engineer stated that there were nine cases within five months which he learned of just by casual inquiry, and that there must be many more of which he had not heard. There was one case where a 5-pound plumb-bob dropped almost 20 feet in the shaft and punctured the hard hat, but only slightly injured the man's head. There was another case where a man working in a shaft was knocked flat by falling material which hit his head, but aside from having a stiff neck he was not hurt. At first there were many cases where the men did not want to wear hard hats, but the company insisted and they were later saved from a serious accident. No opposition is now evident.

This company had three cases where hard-toed boots saved toe injuries. In one case the boot was dented by timber falling from a truck, but the man's toe was saved.

Three cases are reported where men saved injury to their eyes by the use of goggles. These men were breaking chunks on stock piles with a sledge hammer. Their eyes were protected with glass goggles. The glass in the goggles was shattered, but no serious injury resulted to the eyes. In one case a pair of goggles with aluminum cups was badly smashed. The glass was shattered and some pieces entered the workman's eyes. The aluminum cup holding the glass was completely crushed. The injured man's face had the imprint of the goggle on it and the eye was badly bloodshot. There is no doubt that the man would have lost his eye completely if he had not been wearing the goggles. The company has introduced screen goggles in all its underground mines but up to this time has not had much experience with them.

Guarding

Safety rope and belts are used wherever a man is likely to be injured by a fall. Gates are used at raises. Temporary forepoling is used in drifting, and standard slusher guards are employed on all mechanical loading slushers. Pyrene fire extinguishers are placed near all electrical motors. Other fire extinguishers used are Fhister soda, soda-acid, and Phomene.

Medical Service

New employees are given physical examinations and each employee is re-examined every year. Hospital and dispensary service is available to the men. All slight injuries are given first-aid treatment and the injured man is then sent to the doctor.

Accident Records

Reports of the injury are made by the doctor, by the foreman, and by the safety department. A man is paid full time for the day he is injured, the day of injury not being counted as lost time.

If a man is willing to take a less arduous job before he is able to return to his regular job and can earn his daily wage at such occupation, he is returned to work. This is entirely up to the workman, with the permission of the doctor, however, and works to the man's advantage. The injury is not classed as lost time as the man is returned to work, no matter if he has not been returned to his regular job. This policy has more advantages than disadvantages, although it is the subject of much controversy. By keeping a man mentally occupied, his mind is kept off his injury and his recovery is hastened. There is no opportunity to develop a neurosis, or a hallucination that he is still sick. He makes more money than he would by drawing compensation alone.

As permission to return to work is based on the doctor's decision and the man is under the doctor's observation till fully recovered, essentially all valid objections to this policy are removed and the good ones remain. The confidence of the man in his company, that they will back him up when he is injured, is worth much to the morale of the force. This practice has a further actual tendency to reduce the number of accidents, because it serves to show the men how thoroughly the management backs up its safety work and protect the men from injury.

The doctor makes a report on the severity of the accident in the form of an estimate of the time the man will be away from work. If there is any doubt, as to the time required for recovery the workman is given the benefit of it.

Placing Men on Job

The company tries, as far as possible, to give men work which they are mentally and physically capable of doing, avoiding the placing of men with serious defects in hazardous positions.

Table 6 gives the combined safety record of all Pickands, Mather & Co. mines on the Menominee range, and presents details concerning each mine.

Table 6.- Combined safety record of Pickands, Mather & Co. mines on the Menominee range

Year	Average men	Total hours worked	Accidents			Frequency rate, fatal and lost-time accidents per million man-hours worked
			Fatal	Lost-time	No disability	
1920	659	1,667,848	1	76	246	46.2
1921	304	771,559	1	32	63	42.8
1922	635	1,617,957	0	95	281	58.7
1923	1141	2,737,551	1	134	302	49.3
1924	1037	2,692,966	3	157	333	59.4
1925	1229	3,177,892	3	209	509	66.7
1926	1134	2,917,703	6	144	450	51.4
1927	1114	2,829,361	0	149	302	52.7
1928	940	2,313,452	4	79	215	35.9
1929	1009	2,453,370	4	71	294	30.6
1930	944	1,932,663	1	17	200	9.0

Per cent of No-Disability Months to Mine Months Worked

Year	Mine months worked	No-disability months	Percentage of possible perfect record
1927	108	41	38.0
1928	96	53	55.2
1929	96	53	55.2
1930	96	76	79.2

Individual mine safety records of Pickands, Mather & Co. mines on the Menominee range

BENGAL MINE

Year	Average men	Total hours worked	Accidents			Frequency rate, fatal and lost-time accidents per million man-hours worked
			Fatal	Lost-time	No-disability	
1920	208	525,850	0	31	71	59.0
1921	30	77,117	0	6	3	77.8
1922	116	296,089	0	24	56	81.1
1923	178	455,087	1	20	60	46.1
1924	132	337,255	0	25	66	74.1
1925	146	372,770	0	25	90	67.1
1926	99	251,682	0	10	55	39.7
1927	125	314,969	0	33	31	104.8
1928	100	251,081	1	19	28	79.7
1929	107	253,822	0	14	38	55.2
1930	99	78,209	0	2	4	25.6

Individual mine safety records of Pickands, Mather
& Co. mines on the Menominee range - Continued

JUDSON MINE						
Year	Average men	Total hours worked	Accidents			Frequency rate, fatal and lost-time accidents per million man-hours worked
			Fatal	Lost-time	No-disability	
1920	6	14,821	0	1	3	67.5
1921	65	163,926	1	7	16	48.8
1922	119	304,139	0	10	29	32.9
1923	159	407,301	0	6	34	14.7
1924	205	523,490	0	20	46	38.2
1925	168	429,794	2	25	57	62.8
1926	129	325,998	2	22	34	73.6
1927	134	336,872	0	16	36	47.5
1928	113	283,550	1	10	28	38.8
1929	128	310,037	0	13	46	41.9
1930	112	235,500	1	3	40	17.0
BUCK MINE						
1920	26	66,427	0	2	4	30.1
1921	138	350,541	0	15	31	42.8
1922	204	518,623	0	32	116	61.7
1923	154	392,455	0	17	47	43.3
1924	91	232,595	0	5	28	21.5
1925	139	355,036	0	15	38	42.2
1926	127	319,961	0	24	31	75.0
1927	127	322,382	0	12	31	37.2
1928	68	173,026	0	9	16	52.0
1929	108	224,268	1	14	34	66.9
1930	98	207,872	0	3	12	14.4
WARNER MINE						
1920	118	297,526	0	12	17	40.3
1921	42	106,370	0	2	9	18.8
1922	69	175,984	0	4	35	22.7
1923	102	261,600	0	11	35	42.0
1924	78	198,429	1	11	22	60.5
1925	123	313,389	0	20	29	63.8
1926	119	301,830	3	12	33	49.7
1927	118	301,808	0	18	34	59.6
1928	95	238,781	0	1	22	4.2
1929	99	251,219	0	2	13	8.0
1930	101	239,581	0	3	13	12.5
CASPIAN MINE						
1920	301	763,224	1	30	151	40.6
1921	29	73,605	0	2	4	27.2
1922	127	323,122	0	25	45	77.4
1923	209	533,086	0	36	75	67.5
1924	168	431,453	1	19	63	46.4
1925	164	420,132	0	27	63	76.0
1926	149	377,550	0	19	55	50.3
1927	143	364,100	0	26	32	71.4
1928	132	332,953	0	21	22	63.0
1929	152	361,625	0	16	52	44.2
1930	142	307,662	0	2	37	6.5

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Individual mine safety records of Pickands, Mather
& Co. mines on the Menominee range - Continued

EAST VULCAN MINE

Year	Average men	Total hours worked	Accidents			Frequency rate, fatal and lost-time accidents per million man-hours worked
			Fatal	Lost- time	No- disability	
1920	-	-	-	-	-	-
1921	-	-	-	-	-	-
1922	-	-	-	-	-	-
1923	16	28,834	0	0	8	0.0
1924	108	277,967	1	27	49	100.7
1925	164	418,560	0	36	79	86.0
1926	172	448,353	1	11	91	26.8
1927	191	492,434	0	2	62	4.1
1928	206	484,030	0	0	39	0.0
1929	187	482,582	1	2	42	6.2
1930	189	437,970	0	4	46	9.1

JAMES MINE

1920	-	-	-	-	-	-
1921	-	-	-	-	-	-
1922	-	-	-	-	-	-
1923	-	-	-	-	-	-
1924	-	-	-	-	-	-
1925	108	278,317	1	38	62	140.1
1926	126	318,496	0	34	56	106.8
1927	97	246,389	0	36	37	146.1
1928	71	182,404	2	15	24	93.2
1929	74	167,882	1	5	24	35.7
1930	72	157,467	0	0	16	0.0

WEST VULCAN MINE

1920	-	-	-	-	-	-
1921	-	-	-	-	-	-
1922	-	-	-	-	-	-
1923	324	659,188	0	44	42	66.7
1924	255	691,777	0	50	59	72.3
1925	217	589,894	0	23	91	39.0
1926	213	573,833	0	12	95	20.9
1927	178	450,347	0	6	39	13.3
1928	156	367,627	0	4	36	10.9
1929	154	401,935	1	5	45	14.9
1930	132	318,402	0	0	32	0.0

CONCLUSION

Safety organization must be adapted to the needs and peculiar working conditions of the company. The essential requirements of any safety organization, however, are that it shall establish a means of organized inquiry into underlying causes of accidents, and provide authority to be a means of mitigating the causes which can be eliminated.

The mine-safety program should provide, as a standby for emergencies, first-aid treatment and medical service as well as equipment and trained men for rescue and recovery work. The safety department should have at its disposal a complete system of reports and tabulation service to enable it to determine quickly the facts of an accident. These facts may be, among others, causes, location, time of day, and frequency of accidents to individuals or to groups working under unusual conditions. The safety engineer himself usually should not make the actual tabulation of statistics because his time can be used to better advantage. A good system of reports as to accidents, including lost-time and no-lost-time and near-injury accidents with tabulation under various headings, is as much the guide of the safety department as the accounting system is to the financial and managing department.

When this preliminary organization has been set up, the real work of accident prevention begins, embracing as it does a number of phases such as inspection, protection, and guarding, setting up safety standards and regulations, formulating safety rules, enforcing rules and standards through good supervision and wholesome discipline, and raising the safety consciousness of the workmen by safety education. The end to be accomplished is that the workman may be permitted to live with all his limbs and faculties to enjoy his life with his family, and that his wife may keep her helpmate to round out her life with happiness rather than merely existing after his death from accident or infection, with the empty economic comfort furnished by compensation.